> of different sizes and topographical relationships and with one property in common, that they react intensely with osmium tetroxide. But as this means a rather unspecific reaction these granules might chemically be of rather different types.
>
> As to the membranes observed in the cytoplasm these membranes certainly are morphologically very different. It might be possible to propose a definition that would characterize some of these membrane structures and would collect them as morphologically similar. To such morphologically well defined membranes a name could be given. The naming would, however, not increase our understanding but would represent a piece of systematic work. The term "endoplasmic reticulum" (Porter, 1953) is used in a too vague way, it almost indicates anything in the ground substance of the cytoplasm. Without guarantee for homology such diffuse classification certainly does not help very much in systematizing the structural components of protoplasm. (Sjöstrand, 1955b, pp. 226-7)

Securing the Connection to Protein Synthesis

While Porter and Palade were trying to determine the structural character of the endoplasmic reticulum, biochemists in a different line of research were following up on Claude's identification of microsomes in his fractionation studies. Shortly after he discovered microsomes, Claude had noted their high RNA content and, as discussed in Chapter 5, Brachet and Caspersson linked RNA to protein synthesis. Several biochemists attempted a direct assault on the problem of protein synthesis. They saw the formation of peptide bonds between amino acids to form polypeptide chains (Figure 6.11) as the fundamental step in protein synthesis. Their strategy was to trace the uptake of radioactively labeled amino acids into protein and identify the fraction in which it appeared. Harry Borsook of the California Institute of Technology (Borsook et al., 1950) and Tore J. M. Hultin of the Wenner-Gren Institute in Stockholm (Hultin, 1950) were early pioneers, independently showing in 1950 that when the cells of a labeled tissue were broken and fractionated, the highest concentration of labeled amino acids showed up in the microsome fraction.

Paul Zamecnik, at the Huntington Laboratory of Massachusetts General Hospital, played a particularly important role in these biochemical studies. When he initiated his work, two ideas on protein synthesis dominated the landscape. Max Bergmann at the Rockefeller Institute, with whom Zamecnik worked briefly before taking up his position at the Huntington Laboratory, proposed that cathepsin enzymes, which catalyzed proteolytic reactions, might synthesize peptide bonds. Fritz Lipmann, his colleague at Huntington, proposed that a phosphorylated intermediate might play a central role in causing